Poster

In situ synchrotron-based grazing incidence X-ray diffraction study on the solid-liquid interface of graphene oxide

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Thanks to unique 2-dimensional structure, graphene oxide (GO) has attracted much attention in the scientific community and exhibits great potential in energy storage and environmental separation applications. Understanding the interfacial interactions of graphene oxide with metal ions, water or organic molecules will provide valuable insight for these applications. Benefits from synchrotron radiation X-ray with high brightness and photon flux, we have built an in situ multimodal platform at the surface diffraction beamline of BL02U2 in Shanghai Synchrotron Radiation Facility (SSRF), and developed a sub-second time-resolved two-dimensional diffraction technique for studying the solid-liquid interface of graphene oxide. We observed the dehydration behaviour of GO in real time upon annealing at various temperatures, and found that three types of water ("bulk water", "confined water", "bound water") trapped in GO interlayer. Subsequently, we investigated the interactions between metal ions and GO and found that metal cations (Mn^{2+}, Co^{2+}, Cu^{2+}, Fe^{3+}) and GO can self-assemble into a hydroxide/GO superlattice due to the electrostatic interactions. GO/cation ion systems experience four stages with increasing temperature including (1) hydrated cation intercalation into the GO interlayer, (2) GO/metal hydroxide superlattice formation at 250°C, (3) metal oxide nucleation within the rGO interlayers, and (4) complete graphene layer decomposition at 600°C. Moreover, we observed the crystallization behavior of water molecules confined by GO and found that the freezing temperature of water is as low as -35°C and the crystallization of water on the surface and interlayer of is not inconsistent.